Ergonomic Value Stream Mapping (ErgoVSM)

Tool and user guide

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Link to article, DOI:
10.6027/ANP2016-731

Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

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ISBN 978-92-893-4572-9 (PRINT)
ISBN 978-92-893-4573-6 (PDF)
http://dx.doi.org/10.6027/ANP2016-731
ANP 2016:731

Layout: Erling Lynder
Photo p. 4: Jörgen Winkel
Photos p. 35: Kasper Edwards

This publication has been published with financial support by the Nordic Council of Ministers. However, the contents of this publication do not necessarily reflect the views, policies or recommendations of the Nordic Council of Ministers.

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Ergonomic Value Stream Mapping (ErgoVSM)
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Kerstin Ulin, Jörgen Winkel, Kasper Edwards,
Birna Dröfn Birgisdóttir, Sigrún Gunnarsdóttir

Contents

The staff maps a patient flow at a Danish hospital.

Preface

Recent years Lean Production ("Lean") has become a prevalent rationalization strategy in healthcare to create more efficient value streams. Research shows that this often results in impaired Ergonomics, i.e. impaired work content and physical work load ("physical ergonomics"). A common Lean tool used to rationalize value streams in healthcare is Value Stream Mapping (VSM). An ergonomic "add-in module" Ergonomic Value Stream Mapping (ErgoVSM) – has therefore been developed to be used as an integrated part of VSM in the analysis of value streams in healthcare.

ErgoVSM as well as VSM are participative tools. All occupational groups performing tasks directly related to the investigated value stream should be represented when using the tool. This Guide includes description of methods and assessment templates for physical ergonomics and work content.

An initial version of ErgoVSM for manufacturing industry[1,2] was developed in Sweden. Later, this was further developed for the health-care sector[3]. This tool was then evaluated in a Nordic Multicenter Study[4] by national projects in Sweden, Denmark and Iceland. The Nordic evaluation showed that using the ErgoVSM tool may result in more focus on ergonomics in the Action Plans compared to just using VSM. This is obtained without jeopardizing performance aspects.

Based on the field experiences from the Nordic Multicentre Study I, the ErgoVSM tool was further developed, resulting in this present English version.

The Multicentre Study has received financial support from the Nordic Council of Ministers (#11347). Funders of the national projects were AFA Insurance, Sweden (#100063), the Danish Working Environment Research Fund (#46-2010-09) and the University of Iceland Research Fund (#HI1209090106).

The authors thank the employees at the investigated wards and lean organisations at the participating hospitals in Sweden, Denmark and Iceland as well as the employees at the investigated wards.

Caroline Jarebrant
(project leader of the Swedish Study)

Jörgen Winkel
(project leader of the Multicentre Study)

1 Jarebrant C, Mathiassen S E, Winkel J, Öjmertz B. *"Ergonomisk värdeflödes-analys. Handledning"*, IVF-skrift 05801 (28 sidor) och *"Ergonomisk värde-flödesanalys. Arbetsbok"*, IVF-skrift 05802 (13 sidor), IVF Industriforskning och utveckling, 2005. (In Swedish)

2 Jarebrant C, Winkel J, Johansson Hanse J, Mathiassen S E, Öjmertz B. "ErgoVSM: A Tool for Integrating Value Stream Mapping and Ergonomics in Manufacturing". *Human Factors and Ergonomics in Manufacturing & Service Industries,* 26 (2) 191–204, 2016 (doi: 10.1002/hfm.20622)

3 Jarebrant C, Dudas K, Johansson Hanse J, Harlin U, Winkel J. *"Ergonomisk värdeflödesanalys inom vård och omsorg. Handled-ning"*, uppdragsrapport 10/16 (44 sidor) och *"Ergon-omisk värdeflödesanalys inom vård och omsorg. Arbetsbok"*, 10/17 (41 sidor), Swerea IVF, 2010. (In Swedish)

4 Winkel J, Edwards K, Birgisdóttir B D, Jarebrant C, Johansson Hanse J, Gunnarsdóttir S, Harlin U, Ulin K. *"A Nordic evaluation of a work environment com-plement to Value Stream Mapping for increased sus-tainability of patient flows at hospitals – The NOVO Multicentre Study I"*. In: André B, Heldal F, Edwards K (Eds.) Abstract book, The 9th NOVO Symposium: Quality in Health Care. Trondheim, November 12-13, pp 33-35, 2015. DOI: 10.11581/DTU:00000012

Introduction

In Lean Production (a production philosophy and strategy originating from Toyota), value stream mapping (VSM) is an established and useful tool for making value streams more efficient by reducing waste. This increases the proportion of value adding time. VSM is not something done at one individual occasion. The analysis becomes a natural part of the activities at the unit where continuous improvement is sought. Read more about VSM in the book "Learning to See"*. The VSM tool has in recent years also been used in other businesses, for example health care. ErgoVSM, which is based on VSM, contributes to the visibility and evaluation of ergonomics risks that can occur when actions are introduced for greater efficiency.

The target group for use is 1st line managers, business developers, Lean coaches, people responsible for quality and union organisations that together with employees carry out the analysis. The tool is meant to be used in a cross-functional, iterative development process, that is, the development takes place continuously. ErgoVSM is a process tool that is based on active participation among the people involved. By means of its design, the tool can be used for example locally in the work team or at units to perform analyses of consequences with regard to the work environment when improvements are needed and changes are planned. The group that carries out the analysis should be crossfunctional thus allowing the changes to be based on knowledge of work tasks of all occupational groups.

*Read more about Value Stream Mapping in: Rother, M., & Shook, J. (2009). Learning to see: Value stream mapping to add value and eliminate MUDA (version 1.4). Cambridge, MA: Lean Enterprise Institute.

The responsibility, involvement and will of the leadership are a prerequisite for obtaining proper change processes. If this is lacking, the possibilities for change decrease. However, both the leadership and the employees own the process, which therefore should be run in cooperation and in close dialogue.

Starting points and purpose of the analysis
The starting points and purpose for making the analysis must be clear to everyone. This includes what -, how - and who - aspects.

- What do we want to achieve with the analysis and changes?
- How can we achieve this (possibilities and hinders)?
- How is the distribution of responsibility in the change process defined? Is it clear?
- Who should participate in this group? Are all relevant groups and functions represented (functions in the unit, gender and diversity perspectives, etc.)?

Selection of value stream
Start the process by selecting a relevant value stream to map. The following starting points can be used in the choice of value stream:

- It is a recurring value stream in the unit.
- The value stream is in need of change.
- The value stream is clear, that is, it is possible to define it with clear limitations.
- It is suitable also to visualise the work tasks that take place just before and just after the value stream to gain a holistic picture.
- It is most often suitable to choose a specific patient group that is included in the value stream. The choice of patient group clarifies and facilitates the dialogue and the evaluations.

- The work group should include 1st line manager to the greatest possible extent, to have the power to make changes in the value stream or have clear possibilities for influence.

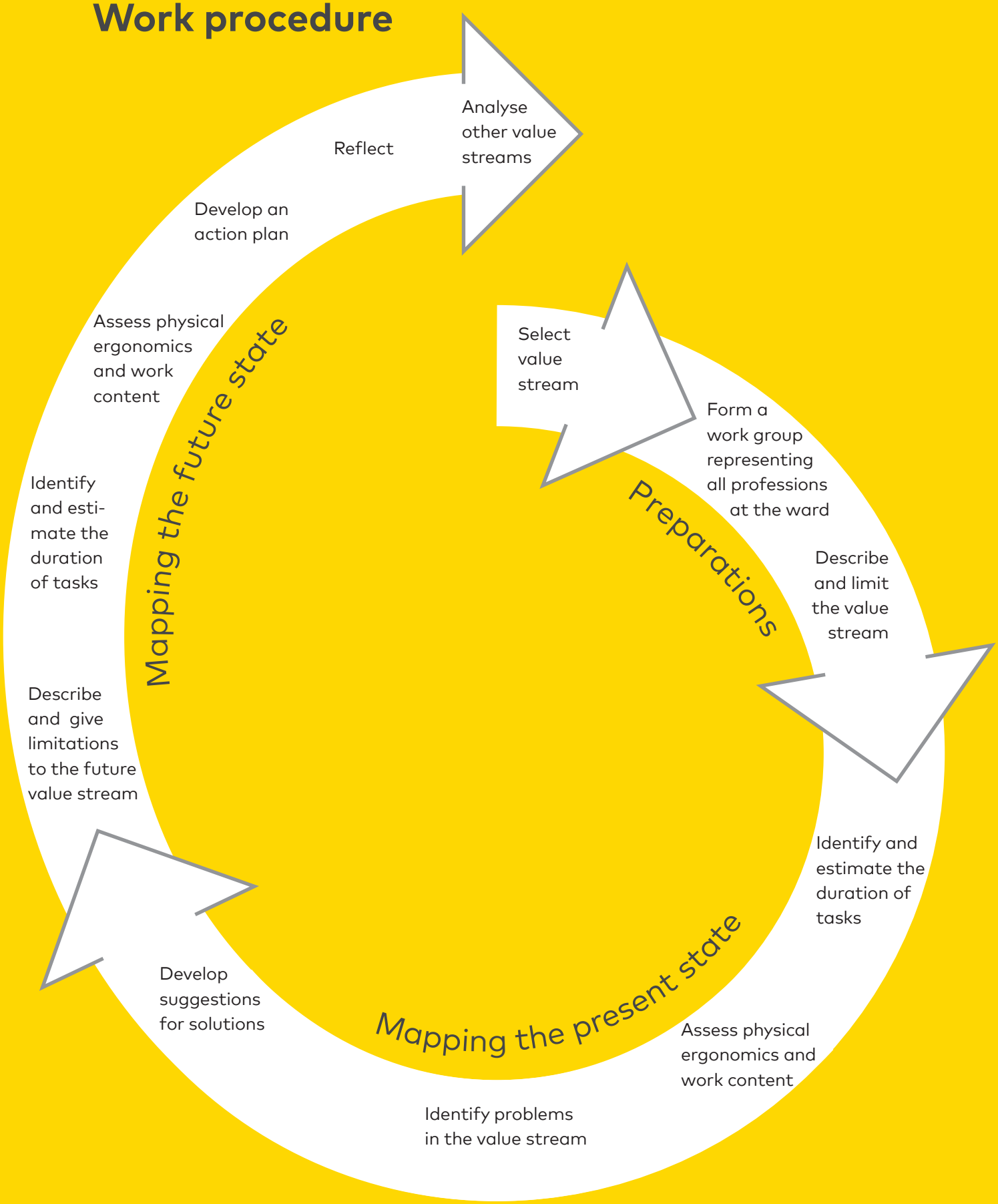
Examples of value streams are the admission process for the patient, the discharge process for the patient, work carried out in the morning at a care unit, the value stream between emergency and other care units, the value stream of patients in a reception unit, etc. The analyses may vary depending on the value stream that is selected. The purpose of the analysis affects the degree of detail regarding the work tasks.

A value stream within a department/care unit is generally easier to analyse and improve compared to value streams between different units. A value stream within a department/care unit is therefore more appropriate to start with.

Assessment templates and their function
To evaluate the work environment (physical ergonomics and work content), ErgoVSM uses assessment templates consisting of a scale from 1 – 10, where 1 corresponds to "very good conditions" and 10 to "very poor conditions". The extreme conditions (1 and 10) are described to facilitate the ratings that best match the perceived current conditions. These values should then be used as references when rating the work environment for the future state in order to evaluate potential consequences of suggested changes. This procedure should be seen as contributing to moving the process forward towards more sustainable solutions (improved efficiency and work environment).

Description	Score
There is always (and/or): – unfavourable postures, e.g. strongly twisted and simultaneously bent – extreme angles of the hand, elbow or shoulder joints – hands above the level of the shoulder or far beyond the distance of the forearm (sitting) or ¾ arm distance (standing) – kneeling	**10** **9** **8** **7** **6** **5** **4** **3** **2**
There is always: – favourable and varied work postures – adaptation to the individual and work task – sufficient space, possibility for free movements, an even floor, support for legs and back, arm support	**1**

Work procedure



Preparations

Anchoring
Before work starts, the decision to perform the analyses should be properly anchored among managers and employees in the organisation. The line managers for each occupational group should be engaged in the analysis – this supports the legitimacy and facilitates decision making about the proposed changes.

Work group that carries out the analysis
Form a cross-functional work group. A suitable number of individuals for the ErgoVSM analyses is 5–7 persons, where all occupational groups that work in the value stream in question are represented. A first line manager should participate in the work group.

Materials needed
The following is needed to be able to visualise the value stream including its activities:

- Plastic film or long sheets of paper that can be put up on a wall (the "map").
- Post-it notes of different colours (one colour for each occupational group), preferably "super sticky" ones (extra adhesive post-it notes).
- Smaller post-it notes for problems and suggestions for solutions.

Form a work group representing different occupational groups

Selected value stream	Person responsible. Plans the implementation, gathers materials etc.
	Work group, name and occupational group

Describe and limit the selected value stream

Preparations	Notes
Motivation for the selected value stream	
Where does the value stream start	
Where does the value stream end	
Day and time that the analysis will study (e.g. weekday, time of day). Give a motivation.	

Plan the execution of the analysis

Time period for analysis:
Information to persons involved:
Mapping the present state:
Desired future state:
Establish an action plan:

Mapping "the current state" and designing "a future state"

Part A –Task level

Identify and estimate the time for work tasks in the stream.

Make an evaluation on a work task level (per occupational group)

Physical Ergonomics
Work Posture (WP)
Weight/Force (WF)
Calculating the Physical Ergonomics (PE)

Work Content
Mental Demands, time pressures (MD)
Control/Influence (CI)

Part B – Value Stream level

Make an evaluation on the value stream level (per occupational group)

Physical Ergonomics
Average Physical Ergonomics (APE)
Physical Ergonomics Potential (PEP)
Physical Porosity (PP)

Work Content
Work Content Potential (WCP)
Mental Porosity (MP)
Communication (social contacts, social interaction) (CO)

Part C – Solutions and action plan

Identify problems on the map of the current state
Develop suggestions for solutions

Form and visualise the future state
Make an action plan
Reflect and evaluate

The analysis covers three parts (parts A, B and C). The group can move between the different parts during the analysis process.

Starting points:

- Parts A and B are carried out first for the current state.
- Problems and suggestions for solutions are made concrete according to Part C.
- The future state is sketched and visualised, where Parts A and B are repeated.
- An action plan is developed to achieve the future state (Part C).
- Finally, the group reflects over and evaluates the analysis they made and how they can work further with other value streams.

Abbreviations

Each aspect of the work environment that is evaluated has an abbreviation/code, e.g. WP for Work Posture, that is to be used on the post-it notes or on the map. See above and page 31 for descriptions of the abbreviations.

Part A

Work task level

Identify and estimate the time necessary for work tasks in the value stream.

Physical Ergonomics	Work Posture (WP) Weight/Force (WF) Calculation of Physical Ergonomics (PE)
Work Content	Mental Demands/time pressure) (MD) Control/Influence (CI)

Part B

Value Stream level

Physical Ergonomics	Average Physical Ergonomics (APE) Physical Ergonomics Potential (PEP) Physical Porosity (PP)
Work Content	Work Content Potential (WCP) Mental Porosity (MP) Communication (social contacts, social interaction) (CO)

Part C

Action plan

- Identify problems on the current-state map
- Develop suggestions for solutions
- Form and visualise the future state
- Make an action plan
- Reflect and evaluate

Part A · Work task level

Identify and make an estimate of time required for work tasks in the value stream

The entire work group

- Set up the plastic film or the paper ("map") on the wall (or place it on a table).
- Decide which colour post-it notes will be given to each occupational group that works in the value stream (represented in the work group). Write the colour coding and the list of abbreviations (see page 31) on the map.
- Distribute post-it notes with the different colours to each occupational group.
- Make a rough time axis (e.g. between 8:00 AM and 12:00 AM) on the map.

Tasks for each occupational group in the work group

- Define and visualise the different work tasks in the value stream selected according to time and affix post-it notes along the time axis (one work task = one post-it note).
- In some cases, more than one occupational group can participate in a work task. Choose a colour code and note that more than one occupational group is involved.
- Make an estimation of the time for each work task (the time for the work task for one patient). The time for one patient is used because a common unit through the value stream is needed and also for comparisons between different value streams. The time needed for five patients, for example, could also be used, as long as the unit is applied consistently. In addition, use the same time unit, e.g. minutes, for all work tasks. Work tasks can sometimes contain actions of different character. However, this should not be too detailed. In the analysis of a value stream within a care unit an appropriate duration of a work task is often between 5 and 15 minutes.
- Make a more careful estimate of the time it takes to carry out all the work tasks in a value stream (for one patient or, if you have chosen e.g. the time, for five patients). For example, work tasks that together take 30 minutes may start at 8:30 and be accomplished only by 10:30.

Example of colour codes for occupational groups

Nurse

Assistant nurse

Physician

Secretary/ administrative

Work Postures (WP)

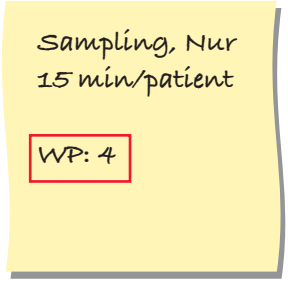
Work posture means the position of the head, shoulders, arms, wrists, trunk and legs when a work task is carried out.

Tasks for each occupational group in the work group
Evaluate each work task in the value stream by going through all the post-it notes. Use the assessment template below where the extremes are described, i.e. the conditions that correspond to score 1 and 10 respectively. Choose the score that best corresponds to the conditions.

Description	Score
There is always (and/or): – unfavourable postures, e.g. strongly twisted and simultaneously bent – extreme angles of the hand, elbow or shoulder joints – hands above the level of the shoulder or far beyond the distance of the forearm (sitting) or ¾ arm distance (standing) – kneeling	**10** **9** **8** **7** **6** **5** **4** **3** **2**
There is always: – favourable and varied work postures – adaptation to the individual and work task – sufficient space, possibility for free movements, an even floor, support for legs and back, arm support	**1**

Work Postures
(Code on post-it note: WP)

Example for nurse (Nur)



Weight/Force (WF)

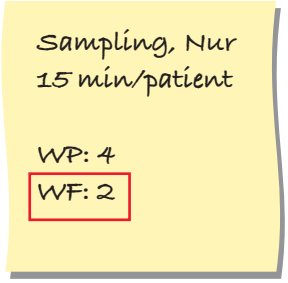
Weight/Force is the weight of things that are carried or the force used toward the surroundings (e.g. a patient who is being supported) in work tasks.

Task for each occupational group in the work group
Evaluate each work task in the value stream by going through all the post-it notes. Use the assessment template below where the extremes are described, i.e. conditions that correspond to score 1 and 10 respectively. Choose the score that best corresponds to the conditions.

Description	Score
Use of force or manual handling of 25 kilos or more Often lifting or manual handling of 15–25 kilos Always poor grip or poor ability to grip	**10** **9** **8** **7** **6** **5** **4** **3** **2**
The work contains very low demands for use of force and manual handling. Grips and ability to grip are adapted individually.	**1**

Weight/Force
(Code on post-it note: WF)

Example for nurse (Nur)



Calculation of Physical Ergonomics (PE)

Task for each occupational group in the work group

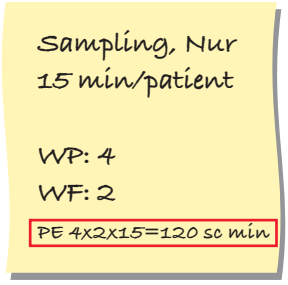
The impact of physical ergonomics depends on the duration of the exposure. On the basis of the ratings on the post-it notes (WP and WF), these values are therefore multiplied by the duration (in minutes per patient) so that a value for the physical ergonomics is obtained for each post-it note. The unit for the multiplication is "score minutes" (sc min).

In the example of the post-it note, (WP)=4, (WF)=2 and time 15 minutes per patient.

The value for Physical Ergonomics (PE) is then:

4×2×15=120 score-minutes (sc min)

Example for nurse (Nur)



Mental Demands (MD)

Mental Demand/time pressure means how quickly the work is carried out, how demanding the work task is, possibilities to accomplish the work task in time and conflicting/incompatible demands.

Task for each occupational group in the work group
Evaluate each work task in the value stream by going through all the post-it notes. Use the assessment template below where the extremes are described, i.e. the conditions that correspond to score 1 and 10 respectively. Choose the score that best corresponds to the conditions.

Description	Score
It is always very difficult to: – have enough time for the work task – have enough time to talk to or get help from co-workers – have enough time to talk with patients and/or relatives – have enough time to get materials – maintain high quality because of demands/time pressure – have enough time to take a short break	**10** **9** **8** **7** **6** **5** **4** **3** **2**
It is always very easy and there are great pos sibilities to: – have enough time for the work task – have enough time to talk to or get help from co-workers – have enough time with patients and/or relatives – have enough time to get materials – maintain high quality – have enough time to take a short break	**1**

Mental Demands
(Code on post-it note: MD)

Example for nurse (Nur)

Sampling, Nur
15 min/patient
WP: 4
WF: 2
PE 4x2x15=120 sc min
MD: 6

Control/Influence (CI)

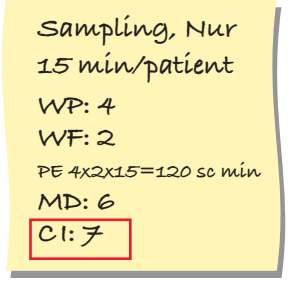
Control/Influence means for example the influence a person has over his or her own work (possibilities for influence), the possibility to make one's own decisions about when and how the work task should be carried out.

Task for each occupational group in the work group
Evaluate each work task in the value stream by going through all the post-it notes. Use the assessment template below where the extremes are described, i.e. the conditions that correspond to score 1 and 10 respectively. Choose the score that best corresponds to the conditions.

Description	Score
There are always very small possibilities to influence: – when and in what way the work task should be done – which sub-operations are included – the sequence of the sub-operations – the time spent on the work task – the flow of patients	**10** **9** **8** **7** **6** **5** **4** **3** **2**
There are always very large possibilities to influence: – when and in what way the work task should be done – which sub-operations are included – the sequence of the sub-operations – the time spent on the work task – the flow of patients	**1**

Control/Influence
(Code on post-it note: CI)

Example for nurse (Nur)



Part A

Work task level

Identify and estimate the time necessary for work tasks in the value stream.

Physical Ergonomics	Work Posture (WP) Weight/Force (WF) Calculation of Physical Ergonomics (PE)
Work Content	Mental Demands/time pressure) (MD) Control/Influence (CI)

Part B

Value Stream level

Physical Ergonomics	Average Physical Ergonomics (APE) Physical Ergonomics Potential (PEP) Physical Porosity (PP)
Work Content	Work Content Potential (WCP) Mental Porosity (MP) Communication (social contacts, social interaction) (CO)

Part C

Action plan

- Identify problems on the current-state map
- Develop suggestions for solutions
- Form and visualise the future state
- Make an action plan
- Reflect and evaluate

Calculating the Average Physical Ergonomics (APE)

Each occupational group performs the following calculation:
The average physical ergonomics (APE) in the value stream is an estimate considering the duration of each task. This calculation is made in order to obtain a comparable value between different occupational groups and different value streams. The result of the calculation gives a score between 1 and 10.

Average Physical Ergonomics (APE)
Example illustrating how to calculate APE:
PE1+PE2+PE3+PE4+PE5+PE6+PE7=1542 sc min
Dur.1+Dur.2+Dur.3+Dur.4+Dur.5+Dur.6+Dur.7=66 min

$$APE = \sqrt{\frac{1542 \text{ sc min}}{66 \text{ min}}} = 4.8$$

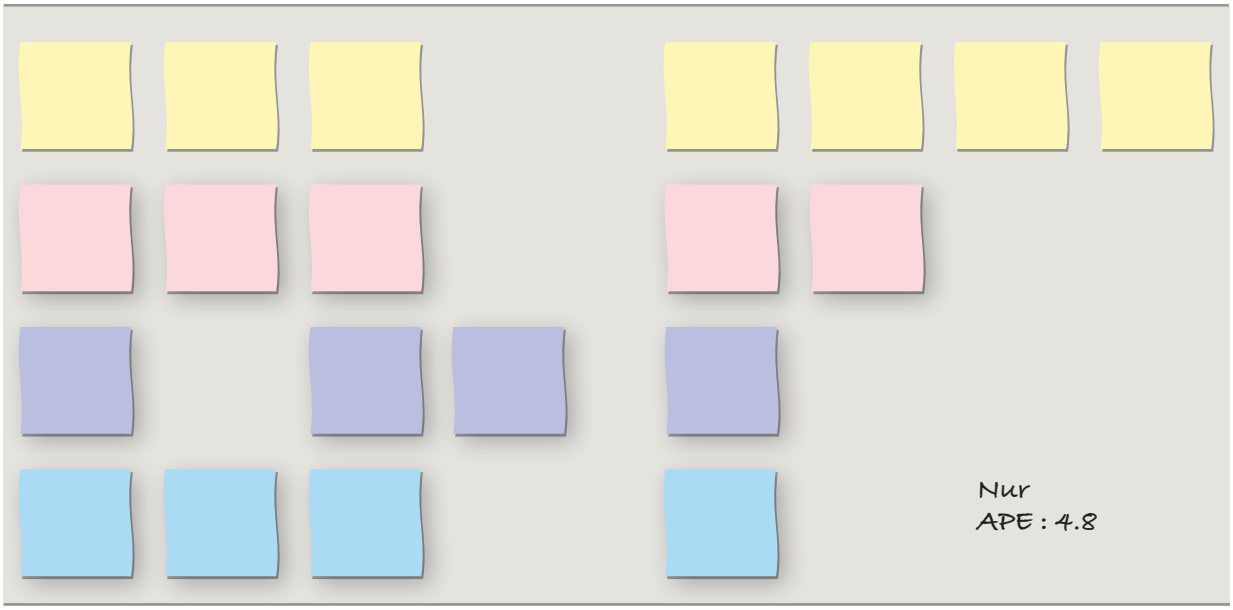
The value is calculated by dividing the PE-value (sum of all post-it notes' values regarding the product of Work Posture, Weight/Force and time, *see page 15*) for each occupational group by the sum the corresponding durations. The following formula is then used:

Each occupational group performs the following calculation:

$$APE = \sqrt{\frac{\text{Physical Ergonomics (PE)}}{\text{total duration}}}$$

The value obtained is given on the value stream map with one decimal.

Example of a value stream map:



Physical Ergonomics Potential (PEP)

Physical Ergonomics Potential is an estimate of the variation in Physical Ergonomics between the tasks in the value stream. This determines the potential to offer physical variation within a value stream.

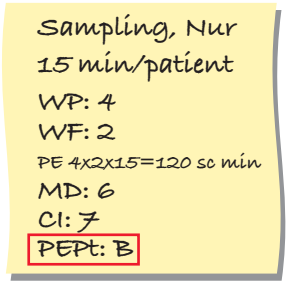
Each occupational group performs the following two steps

Step 1 categorisation:
Categorise the different work tasks (i.e. post-it notes) in the value stream according to the groups below (A-F).
PEPt = Physical Ergonomics Potential for each task

Work task groups (PEPt)	
A	Easy and varied work, i.e. a mix of standing, walking and sitting work, no significant manual handling.
B	Sitting work, no significant manual handling. E.g. Admission talks, computer work, administrative tasks, talking on the phone.
C	Standing and/or walking work, no significant manual handling. E.g. "run", alarm, get/leave materials, distributing medicines.
D	Mainly standing work with manual handling. E.g. distributing medicine or food.
E	Moving, standing and walking work with some weight. E.g. wheelchair transport, easy cleaning, delivery of drip rack, carts, blood pressure monitor.
F	Heavy work, standing and walking. E.g. moving a patient, delivery of food cart, pushing bed or gurney, manual handling of supplies.

Physical Ergonomics Potential
(Code on post-it note:PEPt)

Example for nurse (Nur)



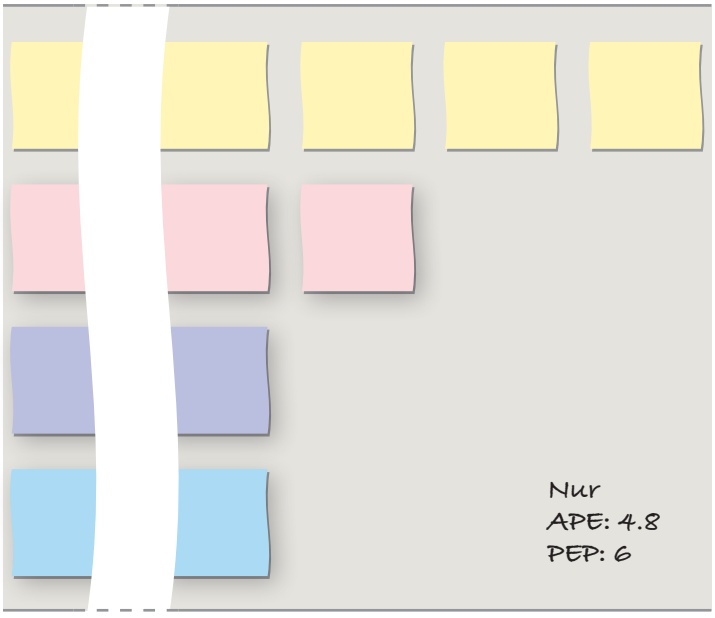
Step 2 Assessment:
Specify which work task groups dominate for each occupational group. Consideration is taken both to the number of tasks in a certain group and to the total duration of the different groups.

Estimate the Physical Ergonomics Potential (PEP), i.e. what range of work tasks (A-F) there are in the value stream for each occupational group, on the basis of the ergonomics work task categorisation that was made in Step 1. Report this on the map.

The assessment template below describes the extremes, i.e. the conditions that correspond to score 1 and 10 respectively. Choose the score that best corresponds to the conditions.

Description	Score
The value stream mainly contains work tasks in one single group of B-F.	**10**
	9
	8
	7
	6
	5
	4
	3
	2
Group A is richly represented in the value stream. There is an even distribution in the value stream between groups B-F and at least four of these groups occur.	**1**

Physical Ergonomics Potential
(Code on the map: PEP)



Work Content Potential (WCP)

Work Content Potential is an estimate of the variation in work content between the tasks in a value stream. This determines the potential to offer mental variation within a value stream.

Each occupational group performs the following two steps:
To be able to manage Mental Demands (MD) in the work, it must offer sufficient Control/ Influence (CI).

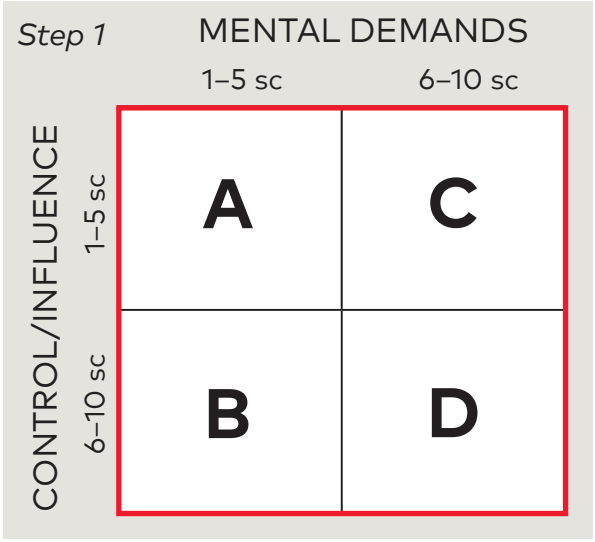
Step 1 categorisation:
Categorise each work task (i.e. each post-it note) in the value stream according to the figure to the right (A, B, C or D).
WCPt = Work Content Potential for each task.

Begin with Mental Demands (MD). These are evaluated to be either "low" or "high".
- Low demands correspond to 1–5 scores.
- High demands correspond to 6–10 scores.

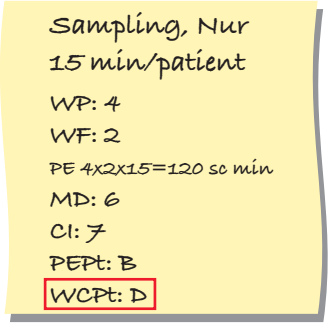
Do the same for Control/Influence (CI).
- High control corresponds to 1–5 scores.
- Low control corresponds to 6–10 scores.

Finally, the column "Mental Demands" and the row "Control/Influence" are combined, and it then appears which letter (A-D) that categorises the work task.

(Code on post-it note: WCPt)



Example for nurse (Nur)



Step 2 Assessment:
Indicate which work task groups (A, B, C or D) dominate for each occupational group.

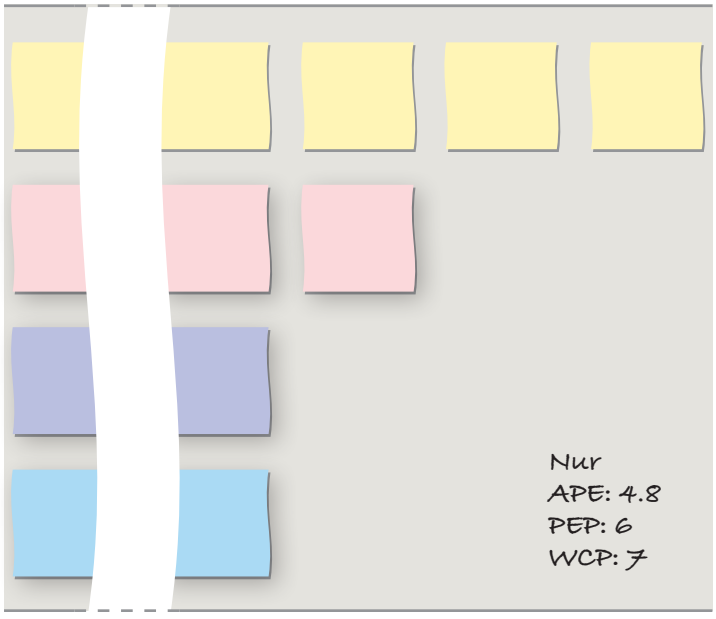
Consideration is taken both to the number of tasks in a certain group and to the total duration of the different groups. Report this on the map.

The assessment template below describes the extremes, i.e. the conditions that correspond to score 1 and 10 respectively. Choose the score that best corresponds to the conditions.

Step 2

Description	Score
The value stream mainly contains work tasks in group D	**10** **9** **8** **7** **6** **5** **4** **3** **2**
There is a balanced distribution in the value stream between groups A-C where group A often occurs. Group D is not present in the value stream at all.	**1**

Work Content Potential
(Code on the map: WCP)



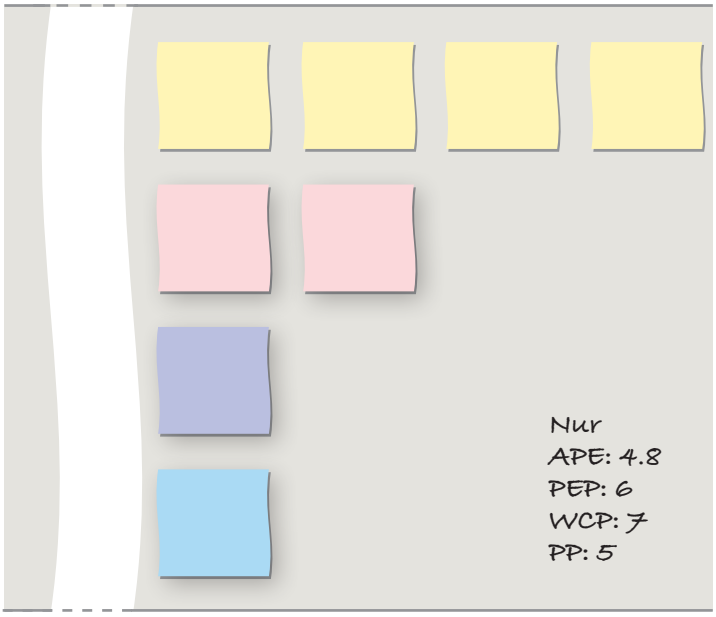
Physical porosity (PP)

Physical Porosity refers to the part of the working time (within and between work tasks) that offers the possibility for physical recovery.

Task for each occupational group in the work group
Each occupational group makes an overall evaluation of the physical porosity in the value stream (a collective value for the whole value stream). The assessment template below describes the extremes, i.e. the conditions that correspond to score 1 and 10 respectively. Choose the score that best corresponds to the conditions. Note the assessment of the Physical Porosity (PP) on the map.

Description	Score
Overall, the work is physically constrained and restricted. Very limited possibilities for physical recovery	**10**
	9
	8
	7
	6
	5
	4
	3
	2
Can control when to get physical recovery Very great possibilities for physical recovery	**1**

Physical porosity
(Code on the map: PP)



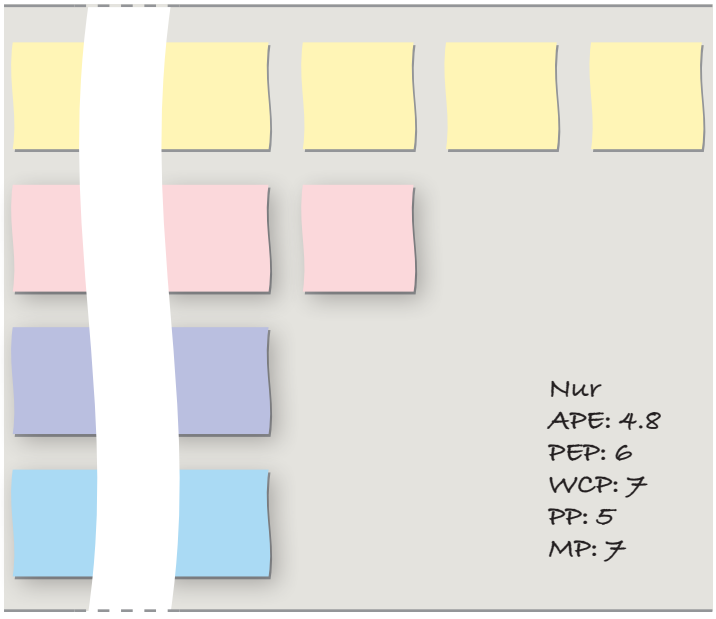
Mental porosity (MP)

Mental porosity is the part of the work time (within and between work tasks) that offers the possibility for mental recovery.

Task for each occupational group in the work group
Each occupational group makes an overall evaluation of the mental porosity in the value stream (a collective value for the whole value stream). The assessment template below describes the extremes, i.e. the conditions that correspond to score 1 and 10 respectively. Choose the score that best corresponds to the conditions. Note the assessment of the mental porosity (MP) on the map.

Description	Score
Overall, the work is mentally constrained and restricted. Very limited possibilities for mental recovery.	**10**
	9
	8
	7
	6
	5
	4
	3
	2
Can control when to get mental recovery. Very great possibilities for mental recovery	**1**

Mental porosity
(Code on the map: MP)



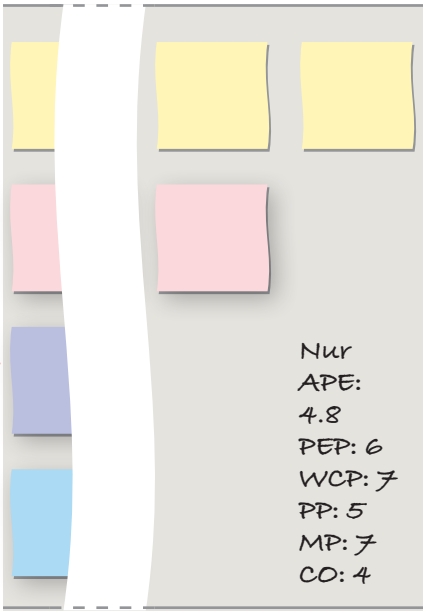
Communication (CO)

Communication is the possibility for social contacts as the work task is being carried out, the possibility to ask co-workers for advice, the possibility to get help in an acute situation etc.

Task for each occupational group in the work group
Each occupational group makes an overall evaluation of the possibility for communication in the value stream (an overall value for the whole value stream). The evaluation form below describes the extremes, i.e. the conditions that correspond to score 1 and 10 respectively. Choose the score that best corresponds to the conditions. Note the assessment of communication (CO) on the map.

Description	Score
There are always *very **small** possibilities* for: – having social/work contacts (i.e. must always work alone) – choosing whether one wishes to have contact with colleagues or if one prefers to work alone – asking co-workers for advice – quickly getting an answer to a call/alarm and help in an acute situation	**10** **9** **8** **7** **6** **5** **4** **3** **2**
There are always *very **great** possibilities* for: – having social/work contacts – choosing whether one wishes to have contact with colleagues or if one prefers to work alone – asking co-workers for advice – quickly getting an answer to a call/alarm and help in an acute situation	**1**

Communication (CO)
(Code on the map: CO)



Part A

Work task level

Identify and estimate the time necessary for work tasks in the value stream.

Physical Ergonomics	Work Posture (WP) Weight/Force (WF) Calculation of Physical Ergonomics (PE)
Work Content	Mental Demands/time pressure) (MD) Control/Influence (CI)

Part B

Value Stream level

Physical Ergonomics	Average Physical Ergonomics (APE) Physical Ergonomics Potential (PEP) Physical Porosity (PP)
Work Content	Work Content Potential (WCP) Mental Porosity (MP) Communication (social contacts, social interaction) (CO)

Part C

Action plan

- Identify problems on the current-state map
- Develop suggestions for solutions
- Form and visualise the future state
- Make an action plan
- Reflect and evaluate

Suggestions for solutions and action plan

After having identified and evaluated the present state according to Parts A and B, the next step is to take decisions about changes and to develop an action plan for an improved future value stream. The aim is to improve both performance and the work environment for all occupational groups. This sometimes goes "hand in hand", but it can also call for consideration and compromises. Remember that participation and dialogue are important in this process. To gain further input, the current-state map that was developed should be presented and be available to all the co-workers at the care unit. They can then give their opinions, suggestions for solutions etc.

Identify problems in the current value stream

- Identify and describe in concrete terms problems/hinders in efficient performance of the work and ergonomics problems.
- Post-it notes (if possible smaller ones) indicating the concrete problems are set up on the current-state map. Mark clearly that these are "problems" that have been identified.
- Prioritise the problems. What is the most important to act upon?

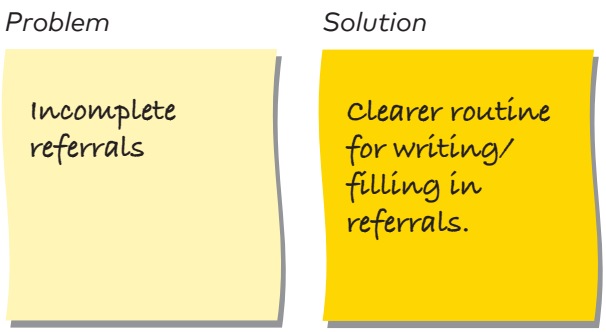
Questions that stimulate creation of solutions

It is important to truly discuss different alternatives and to study the consequences before decisions are taken.

- What problem areas do the analysis point to and why?
- What specific actions are important for improving ergonomics? They may have to do with, for example, high exposures in individual work tasks regarding work postures, weight/force, demands and control.
- How can the Physical Ergonomics Potential (PEP) or the Work Content Potential (WCP) be improved? Is it possible to add or take away work tasks or to change how work tasks are performed?
- Can a change in one part of the value stream affect another part? Can things be done in another sequence?
- Can the work tasks be distributed differently between occupational groups to improve ergonomics? What actions are then needed?
- How can physical/mental porosity in the value stream be increased? (Redistribution of work tasks between occupational groups may be a solution.)

Suggestions for solutions

- Discuss solutions to the problems/hinders that have been described in concrete terms.
- Post-it notes (if possible smaller ones) indicating suggestions for solutions are set up on the current-state map. Mark clearly that these are "suggestions for solutions".



Future-state map with solutions
On the basis of the suggestions for solutions that have been discussed and the solutions that have been chosen, the future-state map is formed collectively by the members of the work group.

- Visualise the future state in exactly the same way as was done for the present state (Parts A and B), i.e. follow the instructions in the manual on pages 10–26 once again.
- Evaluate the future state that has been outlined with regard to physical ergonomics and work content. Have the desired improvements been achieved?
- If the desired improvements have not been achieved, continue the discussions and suggest other changes.
- The developed future-state map should be presented to all employees at the care unit. This may generate more proposals and secure proper anchoring of the action plan.

Action plan
An action plan should now be developed on the basis of the analysis (current state and future state). It is important to write down what to be changed, how to do it and by whom. The needed changes and time schedule for implementation must be given. The action plan should contain concrete actions that can be realized considering issues such as economy, organization and practicalities. Some proposals may be implemented directly, while six months often seem to be a reasonable time period for full implementation of an action plan. Our field experience show, however, that some more complex proposals may demand longer time.

- Develop an action plan including the activities and actions that are needed for implementation.
- Gather support for the action plan among employees and all managers involved.
- Indicate in the action plan what shall be done, who will have responsibility for actions being carried out and when they shall be carried out.
- Plan follow-up occasions for each activity/ action.

An example of for an action plan template is shown on page 30.

Action plan

Example

Value Stream: _____

Work group: _____

Date: _____

Change	Precondi-tions/ Actions	Expected effects	Gaining support	Person in charge	Implemen-tation completed	Follow-up
What needs to be changed/ improved?	What needs to be done so that this will be possible?	E.g. work environ-ment, quality, patient safety, perfor-mance	Support among decision makers/ manage-ment (Yes/No)	Who?	When?	How and when?

Part C · Action plan

Evaluation from the perspective of the care unit

To be able to evaluate the analysis that has been made from the operational perspective of the ward, the following questions need to be answered by each occupational group separately and then be taken up in a dialogue in which all the occupational groups participate. The dialogue and it's results are important for making decisions about how work will be carried out in the future. The continued process with future analyses of other value streams should lead to improvement of the total work of the different occupational groups.

Questions to be answered per occupational group

- What proportion (%) of my occupational group's total work comprises the value stream that has been analysed?
- To what extent does the action plan solve my occupational group's need of changes in the work/work tasks?
- What other value streams would need to be analysed in order to obtain acceptable improvements of my occupational group's total work/work tasks?
- Which of the above named value streams should be given priority for analyses?

Dialogue between all occupational groups

- Each occupational group reports its answers to the above questions.
- Compile the needs for continued analyses.
- Make priorities about which value streams that need to be analysed.
- How do we proceed? Make a plan for further analyses of value streams that have been identified.

Explanation of concepts

(as the concepts are used in ErgoVSM)

- *Action plan:* A plan for changes with activities and measures that is necessary in order to accomplish the changes. This includes a time plan, need of resources and persons responsible for what shall be done in order to achieve the future state.
- *Average physical ergonomics:* Estimated on the basis of work posture and weight/force.
- *Communication:* An estimate of the possibility for social contacts as the work task is being carried out, the possibility to ask co-workers for advice, the possibility to get help in an acute situation etc.
- *Control/Influence:* An estimate of the influence a person has over his or her own work (possibilities for influence), the possibility to make one's own decisions about when and how the work task should be carried out.
- *Cross-functional group:* A group of people with different functional expertice (nurse, assistant nurse, doctor, secretary, possibly more groups) working towards a common goal.
- *Ergonomics:* In the present context:
  - physical ergonomics, i.e. mechanical exposures on muscles, joints and bones
  - work content, i.e. mental demands, control/influence and communication (social contacts and interactions).
- *Lead time:* The collective time from "start to finish" for a defined value stream. This includes time for performing work tasks and the time that otherwise passes from the beginning to the end of a value stream.
- *Mental demands:* An estimate that considers how quickly the work is carried out, how demanding the work task is, possibilities to accomplish the work task in time and conflicting/incompatible demands.
- *Physical ergonomics:* In the present context it is estimated for each task by multiplying the ratings for Work Posture, Weight/Force and the duration (in minutes per patient). *See page 15*.
- *Physical ergonomics potential:* An estimate of the variation in physical ergonomics between the tasks in the value stream. This determines the potential to offer physical variation within a value stream.
- *Porosity:* The part of the work time (within and between work tasks) that offers the possibility for recovery. Physical porosity offers the possibility for physical recovery and mental porosity offers the possibility for mental recovery.
- *Time for a work task:* The actual work time for an individual work task, which can be manual work and/or mental work. Time is calculated per patient.
- *Value-adding:* Activities in the Value Stream that give value to the patient (the opposite of waste).
- *Value Stream:* Includes all activities for creating a product or carrying out a service. This covers both value-adding and non-value-adding activities.

- *Value Stream Mapping (VSM):* A Lean-management method/tool for analysing the current state and designing a future state for the series of events that take a product or service from its beginning through to the customer. In the present context the patient is both the "product" and one of the customers. The method aims at reducing waste in a value stream.
- *Variation:* Pertain to pattern of physical ergonomics and/or work content. A "good" variation is achieved e.g. by combining work tasks that offer different exposures.
- *Waste:* Activities in the Value Stream that do not add any value to the patients.
- *Weight/Force:* The weight of things that are carried or the force exerted toward the surroundings (such as a patient that one supports) in work tasks.
- *Work content:* The collective work tasks of an occupational group (e.g. in a value stream), the work performed and demands for contact/contact network. In ErgoVSM, work content is estimated with a focus on mental demands, control/influence and communication.
- *Work content potential:* An estimate of the variation in work content between the tasks in a value stream. This determines the potential to offer mental variation within a value stream.
- *Work postures:* Position of the head, shoulders, arms, wrists, trunk and legs when work tasks are carried out.
- *Work task:* An activity that can be limited to a meaningful, coherent entity performed by a person.
- *Work task group:* Group of work tasks offering similar physical ergonomics or mental demands.

Abbreviations:

APE	Average Physical Ergonomics
CI	Control/Influence
CO	Communication
MD	Mental Demands
MP	Mental Porosity
PE	Physical Ergonomics
PEP	Physical Ergonomics Potential
PEPt	Physical Ergonomics Potential for each task
PP	Physical Porosity
WCP	Work Content Potential
WCPt	Work Content Potential for each task
WF	Weight/Force
WP	Work Posture

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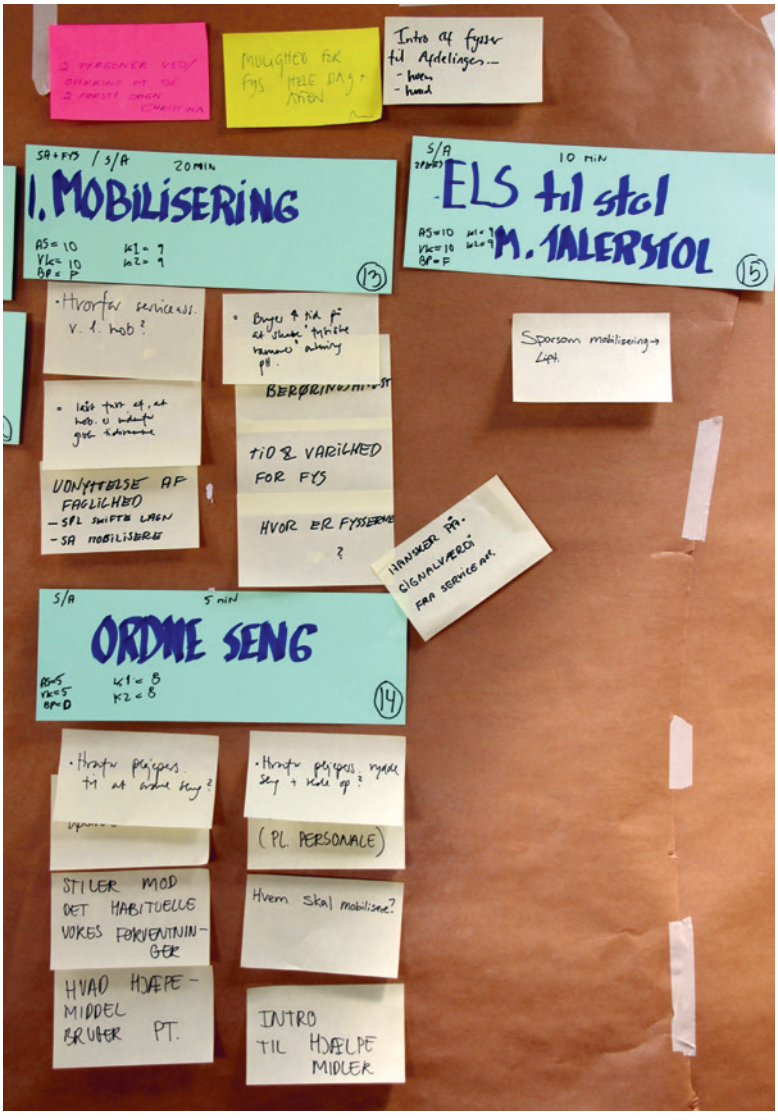

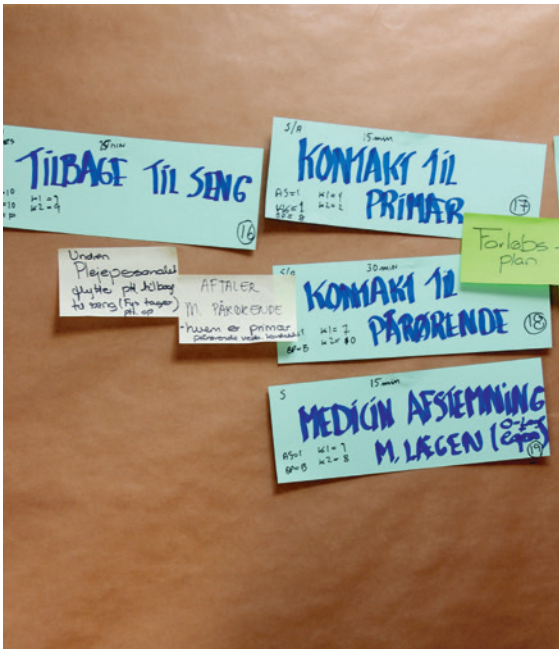

The final Value Stream Map from a Danish ward (top) and parts of their Action Plan: Blue post-it-notes with a number in a circle (text in Danish).

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ErgoVSM – for what purpose?

ErgoVSM is an intervention process tool stimulating a dialogue for creating more sustainable value streams at hospital wards. It represents a complement to traditional Value Stream Mapping. Work environment issues are integrated in the Lean-management method Value Stream Mapping. The focus is to describe the current state through dialogue and visualisation followed by designing a future state and developing an action plan. During this process, performance, physical ergonomics and work content are considered.

ErgoVSM – for whom?

ErgoVSM targets 1st line managers, business developers, Lean coaches, people responsible for quality and union organisations that together with employees carry out the analysis.

If you are familiar with making value stream mapping, you will recognise the work procedures. The tool offers a complement that makes it possible to work with the work environment as an integrated part of the organizational development.

ErgoVSM – how?

A value stream in an activity or business is selected for analysis. The analysis group includes representatives from all occupational groups working in the value stream. The group defines and visualises the value stream (the current and future state) and develops an action plan together with the manager. The value stream mapping is supplemented with an evaluation of physical ergonomics and work content.

ANP 2016:731
ISBN 978-92-893-4572-9 (PRINT)
ISBN 978-92-893-4573-6 (PDF)